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SOME PINEAPPLE PROBLEMS.

13th ARTICLE. - WATER CONTENT OF THE LEAF AND REACTION OF THE SAP.

By Henry C. Henricksen.

WATER CONTENT. - The sharp pointed apex is the oldest part of the leaf and, therefore, the most mature and least watery. The base, that is yet covered by the surrounding leaves, and, therefore, white in color, is the last formed and the tissue is more watery than that above. The intervening portion, being crescent shaped, that is with the edges upturned, is dry towards the sharp edges but very watery in the fleshy center. The water is located principally in the upper half of the leaf which consists of colorless water-storing tissue. The lower half, which contains the skeleton of the leaf, consisting of the supporting fibres and the spongy tissue carrying the chlorophyll, is much less watery. In a young, fast growing leaf, the two layers are of equal thickness, although the water-storing layer may be the thickest. It diminishes with age or with a cessation of growth and in the partly dried-up leaf it entirely disappears.

As to the water content of the different sections the following figures are representative of the normal leaf: leaf base 91%, middle section 85%, apex section, of about 10 inches, 80%. When the growth is very vigorous, as it is in a plant from which the heart has been burned out, or in one that has been fertilized with potassium nitrate the moisture of the middle section may be as high as 92% to 94%. On the other hand when growth is retarded and the retardation is of a nature which deprives the plant of water, such as the roots being eaten by grubs, the moisture content may drop to considerably below 80%. In leaves with a water content of 80% the water-storing tissue will have collapsed, or practically so. And when the content goes much below that the tissue will lose its capability of again taking up water; in other words the leaf will cease to function.

The transpiration loss is governed by the state of growth and by atmospheric conditions. The leaves from a young, fast growing plant, may lose as much as 6% of its own weight each 24 hours by transpiration. An average plant, with a leaf area of 8 to 10 square feet will, under average conditions, lose but about 3% in 24 hours. From an older, or slower growing plant, the loss will be less. These figures are according to results obtained with pot grown plants in the open air and under controlled conditions in a calorimeter where the loss from transpiration and respiration could be calculated separately. From plants that are not growing, such as slips and suckers, the transpiration loss lessens with time from picking as illustrated by the following figures.

TRANSPIRATION LOSS. - Slips were kept in a calorimeter through which a current of moisture-free air was drawn at the rate of 30 to 60 liters per hour at a temperature of 26 C. The loss in weight was determined each 24 hour period and found to be as follows:

1st period	2.8% of weight of slips;	4th period	1.8% of weight of slips;
2nd period	2.3% of weight of slips;	5th period	1.3% of weight of slips;
3rd period	1.9% of weight of slips;	6th period	0.8% of weight of slips.

These slips were kept for another period of 5 days at a temperature of 26°C and an average relative moisture content of the air of 75%. They lost in weight during that time 0.6% each 24 hours.

The effect of moisture in the air is illustrated by the following figures: Slips were noted four days after picking. The loss was 1.7% during the first 24 hour period and 0.5% during the sixth period when kept at 26°C and 75% relative humidity. They were then placed in a calorimeter under a current of dry air and the loss raised to 2% for each of two 24 hour periods. After that, saturated air was passed through the calorimeter for 72 hours and the loss was again reduced to 0.5%. This will serve to illustrate the effect on the plants in the field of dry windy weather compared with that of a day when no wind is blowing and the air is nearly saturated with moisture.

REACTION OF SAP. - The pH, or hydrogen ion concentration, was determined on more than one hundred samples taken from plants in various stages of growth. The plants were pulled up entire, the material was ground in a food chopper within a few hours and the pH determined with a potentiometer using the quinhydrone method. From the results obtained it appears that the middle section, excluding white base and 10 in. apex, of an average normal mature leaf will show a pH of 6.0 to 6.3. The reaction is always more basic towards the apex and more acid towards the base. For instance, if a small section from the middle of the leaves show a pH of 6.3 the apex section will show 6.4 and the lower section 6.2, while in the white bases it will be 5.8, although it may go as low as 5.2.

The same proportion is maintained, more or less, consistently, when comparing the leaves of one plant with those of another. The young vigorous growth always shows a pH several points below that of the less vigorous. For instance, vigorous growth produced by fertilizing with ammonium sulphate and potassium sulphate without phosphate may show a pH of 5.5 in the middle section and 5.0 in the white bases. With phosphate, all other conditions being equal, the pH is always several points higher. An extreme case is on record in which both the green part and the white bases showed a pH of 5.0. That was from a plat in which the hearts of the plants had, purposely, been burned out with inorganic fertilizers. The growth following such treatment is always extra vigorous and the low pH is due entirely to conditions following that, shown by the fact that after the leaves matured it raised to 6 or over. Extreme figures towards the basis side were also obtained. Reddish, leathery leaves from some plants showed a pH of 6.8 and the white bases 6.2.

The figures given above are, by no means, invariable. A tabulation of pH determinations on leaf material from plants that appear to be similar show considerable variations. But in all probability the pH figures give a closer indication of the state of growth that can be discerned by the eye. Certainly it is safe to state that an apparently normal leaf, the sap of which shows a pH several points below 6.0, is functioning rapidly, whereas a similar leaf of which the sap is 6.5, or above, is functioning very slowly. That rule cannot, however, be applied without some modification to a young chlorotic plant, for the sap of such a one may show a pH below 6.0 as long as the water content remains at 85% or more. In old leaves with a water content of about 80% the pH raises as in normal leaves.